Cover Crops and Nitrogen

Credits

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Cover crops and N credits

- Review of cover crop systems in WI
- Review of recommended N credits
- Highlight field research
Types of cover crops used in WI

Cool-season grasses

Green manures
Cool season grasses

- Oats, rye
  - Grow quickly
- Provide ground cover in systems that have little crop residue
  - Potatoes
  - Corn Silage
- “Trap” crop for nitrate
- Build soil organic matter
Is there an N credit for cool-season grasses?

- No
- A reduction in N rates with use of cool-season grasses has not been shown to be effective in midwestern cropping systems
- …but are there other advantages?
Potential yield increase on sandy soils
Legume cover crops (aka Green Manure)

- Add free N to soil system
- Take longer to establish than rye or oats
- Planted after “short-season” crops (wheat, vegetables) for N addition to high N demand crops (corn)
Why does it work?

Biological fixation

Late Fall

Mineralization

Spring
Why does it work?

Legume N release or Corn N uptake (% of total)

Weeks after planting

Legume N Release
Corn N Uptake
Table 9.5. Green manure nitrogen credits.

<table>
<thead>
<tr>
<th>Crop</th>
<th>&lt; 6” growth</th>
<th>&gt; 6” growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alfalfa</td>
<td>40</td>
<td>60–100</td>
</tr>
<tr>
<td>Clover, red</td>
<td>40</td>
<td>50–80</td>
</tr>
<tr>
<td>Clover, sweet</td>
<td>40</td>
<td>80–120</td>
</tr>
<tr>
<td>Vetch</td>
<td>40</td>
<td>40–90</td>
</tr>
</tbody>
</table>

*Use the upper end of the range for spring seeded green manures that are plowed under the following spring. Use the lower end of the range for fall seedings.

*b If top growth is more than 12 inches before tillage credit 110–160 lb N/a.
Ruffo and Bollero (2003) Univ. Illinois
Research – Lancaster, WI

- 1999, 2001
- 7 cover cropping systems
  - None
  - Alfalfa
  - Hairy Vetch
  - Red Clover
  - Medic
  - Berseem Clover
  - Crimson Clover
Research – Lancaster, WI

- Cover crops planted after winter wheat harvest
- Corn planted following spring
- 1999: 0, 30, 60, 90, 120, 150 lb-N / ac
- 2001: 0, 25, 55, 80, 100, 135 lb-N / ac
Research – Lancaster, WI

- How do we evaluate the N credit?
- Build response curves for each system
- Determine the economic optimum N rate and yield at optimum N rate (0.1 N/corn price ratio)

![Graph of Corn yield vs. Fertilizer N rate with $R^2 = 0.9428$]
<table>
<thead>
<tr>
<th>1999</th>
<th>EONR</th>
<th>Yield @ EONR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>lb/a</td>
<td>bu/a</td>
</tr>
<tr>
<td>Fallow</td>
<td>105</td>
<td>(87 - 123) 204</td>
</tr>
<tr>
<td>Hairy Vetch</td>
<td>86</td>
<td>(72 - 97) 209</td>
</tr>
<tr>
<td>Alfalfa</td>
<td>150+</td>
<td>209</td>
</tr>
<tr>
<td>Red Cl.</td>
<td>150+</td>
<td>205</td>
</tr>
<tr>
<td>Medic</td>
<td>150+</td>
<td>216</td>
</tr>
<tr>
<td>Berseem Cl.</td>
<td>84</td>
<td>(67 – 101) 207</td>
</tr>
<tr>
<td>Crimson Cl.</td>
<td>67</td>
<td>(51 – 83) 204</td>
</tr>
</tbody>
</table>

N credit = 19 to 38 lb/a (average) 26 to 40 lb/a (high end) 14 to 36 lb/a (low end)
<table>
<thead>
<tr>
<th>Crop</th>
<th>EONR</th>
<th>Yield @ EONR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fallow</td>
<td>96</td>
<td>(82 – 109)</td>
</tr>
<tr>
<td>Hairy Vetch</td>
<td>27</td>
<td>(10 – 44)</td>
</tr>
<tr>
<td>Alfalfa</td>
<td>83</td>
<td>(64 – 103)</td>
</tr>
<tr>
<td>Red Cl.</td>
<td>51</td>
<td>(39 – 63)</td>
</tr>
<tr>
<td>Medic</td>
<td>69</td>
<td>(59 – 79)</td>
</tr>
<tr>
<td>Berseem Cl.</td>
<td>84</td>
<td>(73 – 95)</td>
</tr>
<tr>
<td>Crimson Cl.</td>
<td>56</td>
<td>(47 – 65)</td>
</tr>
</tbody>
</table>

N credit = 12 to 69 lb/a (average)  
6 to 65 lb/a (high end)  
18 to 72 lb/a (low end)
Conclusions

- There is significant value to using legume cover crops/green manures in a winter wheat-corn rotation
- There will be year to year variability with cover crop benefits.
- Other legume cover crops are beneficial to Wisconsin cropping systems.
Questions?